PROCEEDINGS OF THE SECOND ANNUAL CONVENTION OF THE AMERICAN ASSOCIATION OF STATE WEATHER SERVICES, WITH BRIEF REFERENCE TO FORMER CONVENTIONS.

JAMES BERRY, Secretary.

During the latter part of 1885 the Chief Signal Officer issued a letter to interested parties, suggesting a convention of the directors of the State weather service organizations existing at that time. The suggestion was favorably received and a very profitable conference was held at the Smithsonian Institution in Washington City on February 24 and 25, 1886. No further meeting of the directors of State weather services was held until the summer of 1892, when, at the suggestion of the present Chief of the Weather Bureau, arrangements were made for a convention to be held August 15 and 16 in Rochester, N. Y., in connection with the meeting of the American Association for the Advancement of Science. At this second convention of State weather service directors, at which eighteen State services were represented, a permanent organization, known as the American Association of State Weather Services, was effected, and the results of the meeting were most encouraging. The proceedings of the convention formed a very interesting publication, which was issued as the "Report of the First Annual Meeting of the American Association of State Weather Services."

On August 1, 1893, the following letter announcing the date of the Second Annual Convention of the American Association of State Weather Services, with list of topics for discussion, was addressed to the directors of the several State weather services by Major H. H. C. Dunwoody, the president of the association:

SIR: After consultation with the Chief of the Weather Bureau it has been decided best to hold the convention of the American Association of State Weather Services for 1893 in Chicago (not at Madison, Wis., as was expected) at the time and place of the meeting of the Meteorological Congress at the Art Palace of Chicago, Lake front, foot of Adams street, in that city, August 21–25, 1893.

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TOPICS FOR DISCUSSION AT THE MEETING OF THE AMERICAN ASSOCIATION OF STATE WEATHER SERVICES TO BE HELD IN CHICAGO, ILL., AUGUST 21–25, 1893.

1. Inspection of stations of observation and display stations annually, to form the acquaintance of the observers and displaymen and to instruct and encourage them in their work.

(*a*) Importance of location of instruments, and elevation of instrument-shelter above ground.

(*b*) Instruments and shelters to be supplied by the Weather Bureau.

2. The necessity for sufficient weather-crop correspondents to make the data in weekly weather-crop bulletins thoroughly reliable.

(*a*) Time of day of issue of the weekly bulletins. Should they not be issued Tuesday afternoon, and is it not advisable to manifold sufficient copies for the press of the State by means of the milliograph process.

(*b*) The best method of printing the weekly bulletin, and at whose expense.

3. Uniformity in method and class of data published weekly and monthly.

4. Importance of directors and assistants in charge making a special study of the crops grown in the State. Since the majority of States have experimental stations, and that these stations are also voluntary stations, should not the date of inspection of such stations be prolonged to several days so as to give the student time to learn the important details connected with the growth of the several crops, etc.

5. Value of an annual convention of the voluntary observers, displaymen, and weather-crop correspondents in each State—some State Fair day, or at such time when the people of the State are drawn together.

6. Is the work of the director or assistant in charge of a State service of such magnitude as to make his duties as local forecast official or observer in charge of station too onerous to give him the time to do as well for his service as he could do if he had only the duties of director.

7. Relation of State weather services to experimental stations, and what will improve them.

8. The necessity for more accurate measurement of snowfall.

9. The value of frost predictions and the best method of making them locally.

10. Methods of protecting tender crops from frost.

In pursuance of the above call the convention met in Chicago on the dates named, and the following is a report of its proceedings:

First session.

The convention was called to order by Vice President Pague, of Oregon, at 11 a. m., August 21, in Hall 30.

On motion, the convention adjourned until 10 a. m., 22d, owing to the absence of the Chief of the Weather Bureau, the President of the Association, and other members.

Second session.

Convention called to order by Vice President Pague. Members present: Prof. M. W. Harrington; Messrs. Clarke, Arkansas; Craig, Illinois; Sage and Chappel, Iowa; Jennings, Kansas; Burke, Kentucky; Kerkam, Louisiana; Hyatt, Mississippi; Evans and Conger, Michigan; McNally, Missouri; Loveland, Nebraska; Turner, New York; Strong, Ohio; Widmeyer, Oklahoma; Pague, Oregon; Ball, Pennsylvania; Doherty, South Dakota; Harmon, South Carolina; Salisbury, Utah; Ryker, Virginia; and Moore, Wisconsin, with Messrs. Wilson, Memphis; Clayton, Boston; and Frankenfield, Chicago, as visitors.

The following letter from the absent President of the Association was read:

To the AMERICAN ASSOCIATION OF STATE WEATHER SERVICES:

GENTLEMEN: It is hardly necessary for me to say how much I regret my inability to be present with you on the occasion of the second annual meeting of the association; having in mind the reunion of last year when I had the pleasure of being with you personally, and taking part in discussions which, I am able to say, resulted in much benefit not only to the State services but to the individual members of the association as well. It is, therefore, a source of regret to me that my official duties render impossible my attendance at the Chicago meeting. My interest in the success of these State services increases with their growth, realizing as I do the close relation they bear to the National Service, and the means which they afford for increasing its benefits to the public.

The association may justly regard with pride and satisfaction the operations of the past year, since they mark the most successful period since the organization of the State weather services. For these gratifying results we are indebted to the present Chief of the U. S. Weather Bureau, Prof. Mark W. Harrington. His high appreciation of this branch of meteorological work, his clear insight into the capabilities of these State services co-operating with the National Service, and the generous support which he has uniformly given them have been potent factors in increasing the value of this work. Without the aid of the Bureau over which he has the honor to preside, many of the State services now successfully operated could not be maintained.

When our association last adjourned it was with the expectation that the following meeting would be held at Chicago. Although preliminary arrangements were made for meeting at Madison, Wis., after consultation with the Chief of the Weather Bureau, I assumed the responsibility of calling the association to meet in conjunction with the Meteorological Congress, and I am convinced that this change will result in a more satisfactory meeting. It will also enable the attending members to avail themselves of the advantages of the discussions bearing upon the science of meteorology, which discussions must prove of great value to them in the prosecution of their work.

In preparing the topics for discussion, I have again received valuable suggestions from the Chief of the National Bureau, and I have extended the list of topics to include discussions upon the relations of the State services to experimental stations; the value of frost warnings, and the methods of protecting tender crops from frosts. The full discussion of these latter subjects is particularly desirable, as a more perfect understanding of them will increase the field of usefulness of the National Service.

To the subjects announced in the list of topics for discussion, it might be well to add one relative to the distribution of forecasts as at present operated. During a recent visit in central New York, I observed several stations where the forecasts are regularly received by telegraph. I found that the absence of a telegram (which we all understand to mean "fair and stationary") was an indication to the observer that he should not display flags; at least the flags were displayed only when the change from "fair" to "rain," or "local rain" was announced. A question, therefore, is: Would it not be better to send the message daily without regard to conditions, and thus keep up interest in the service? These omissions of the telegraphic message are likely to cause great carelessness in the general displays. This is the impression I received from the observer in charge of the New York service, independently of the local stations visited by me.

I deem it proper also to invite the attention of the association to the annual report of the Chief of the Weather Bureau for last year, which contains extracts from the report of the Secretary of Agriculture. Here may be found a general view of the weather conditions, as noted from week to week in each State during the season. Observers in charge of the State weather services have been requested to continue this summary for the current season, with a view to its publication in the Secretary's report, thus securing the distribution of 400,000 copies of a reliable reference to seasonal conditions as they occur from year to year, the idea being to continue this feature as a part of the annual report of the Department of Agriculture. The weather crop services of the country depend upon the organization which you represent, and the public's appreciation of these services is increasing from year to year. Effort should be made, therefore, to place this information in such form as to secure for it the widest possible distribution.

While the crop service is the most appreciated, yet there are other valuable features of these organizations that should not be overlooked. These organizations are also to assist in the rapid distribution of forecasts and cold-wave warnings. That this branch of the work may be extended, each chief of service should ascertain the localities in his State wherein these warnings may be most useful, and efforts should be made to secure special facilities for the distribution of the information over threatened districts. As so much depends upon the character of the meteorological data collected, attention should be given to the exposure of instruments; they should be inspected when practicable and the local observers instructed in the proper use of them.

In conclusion, I desire to thank the association for, and express my high appreciation of, the honor conferred upon me at the last meeting by selecting me for your first president. In relinquishing the office it is my wish to reassure the members of the association that the interest which I have felt in these State weather services since my first suggestion for their organization shall continue.

Again expressing my regret that I must forego the pleasure of attending the Chicago meeting,

I am, very truly, yours,

H. H. C. DUNWOODY.

WASHINGTON, D. C., *August* 19, 1893.

The Chairman called attention to the necessity for the election of officers, but on motion such election was deferred until the close of the meeting.

Secretary Kerkam desired the assistance of a member to act as temporary secretary, and Mr. McNally was elected to the office for the session.

The first subject for consideration was the "Inspection of stations of observation and display stations annually, to form the acquaintance of the observers and displaymen and to instruct and encourage them in their work." This was discussed by Messrs. Jennings, Moore, Clarke, Salisbury, Evans, and Conger, and the cost of such inspections in the different States and Territories was estimated at from $100 to $150 per annum, the discussion leading to the adoption of the following resolution:

Resolved, That it is the sense of this convention that the sum ot $100 be annually allotted by the National Weather Bureau to each State weather service for the purpose of inspection.

The importance of location of instruments and elevation of instrument shelters above ground, and supplying instrument shelters and instruments, was freely discussed. Resolutions covering the furnishing of instruments and shelters were prepared, and it was the sense of the convention that the elevation of the bottom of shelters should be 4½ feet above the ground. Mr. Pague of Oregon detailed at length experiments that he had made with varying exposures at different heights, and he too found that the 4½ foot elevation gave results varying but slightly from those of other elevations that had been used by voluntary observers of the Oregon service.

The following resolution, by Mr. Salisbury of Utah, was adopted:

Resolved, That instruments and shelters should be supplied to voluntary stations by the U. S. Weather Bureau, and that when so supplied the installation should be done by the director or assistant director, and that the necessary expenses of such establishment of stations should be paid by the National Service; said establishment being considered a part of the annual inspection of voluntary stations.

Upon invitation of Prof. Harrington to members of the association to visit the Meteorological Congress in session in the same building to listen to papers to be read that bore directly upon state weather service work, the convention adjourned until 2 p. m.

Third session.

The convention was called to order by the First Vice President, but no quorum being present, adjourned to 10 a. m. of the 23d.

Fourth session.

Convention called to order by Vice President Pague at 10 a. m. 23d. The minutes of the preceding meeting were read and approved. Messrs. Salisbury, Burke, and Evans were appointed a committee on resolutions.

The second subject, "The necessity for sufficient weather-crop correspondents to make the data in weekly weather-crop bulletins thoroughly reliable," was then taken up.

Mr. Kerkam was of the opinion that each county should have at least five weather-crop correspondents, one of whom should be the voluntary observer, who would furnish the meteorological data in detail. He stated that there was no lack of correspondents to be had, provided there was a co-operation between the State agricultural society and the State weather service; that he had some 600 available to call upon at all times who would render reports, but that only about 300 were necessary to give five to a parish or county in Louisiana.

Messrs. Pague and Jennings entered into the discussion, and Mr. Chappel stated that the reporters of the Iowa service were principally farmers, and that he had some 1,200. Mr. Sage, also of Iowa, said that he had three classes of reporters, the voluntary observers, rainfall reporters, and the regular crop reporters; he preferred having 100 weekly reports to 200, and 500 monthly crop reports to 1,000 or more, since he could better digest the reports when there were not so many. Messrs. Salisbury and Craig spoke, and Mr. Clarke suggested publishing the individual county reports in the weekly bulletins; he said he had from 190 to 215 weekly reports and found no trouble in compiling them into a bulletin.

Mr. Kerkam asked about the number of weather-crop reporters required to give best results. Mr. Moore thought 100 would be sufficient. Mr. Clarke differed, and thought more were needful, and as many as could be handled. Mr. Jennings placed the number at 250, and advocated the distribution of charts in order to secure the several kinds of data desired. Mr. Evans deemed it advisable to have at least 400 reporters, and stated that he experienced but little trouble in compiling data. Mr. Strong was opposed to limiting the number, stating that he had 1,263 correspondents in Ohio, and that he received about 1,000 reports each week. Mr. Salisbury spoke at some length upon this subject, and Messrs. Ball, Clarke, and Moore offered the suggestion of having as many as could be handled intelligently.

Mr. Clarke, Arkansas, here offered the following resolution, which was adopted:

Resolved, That it is the sense of this meeting that the number of crop correspondents in the various States and Territories be left to the judgment of the directors of said services; but it is desirable that a sufficient number (100 or more) should be obtained to give accurate crop conditions.

As to time of issuing weather-crop bulletins, Mr. Sage expressed himself unfavorably towards Tuesday, claiming that as the worst day of the week; on the contrary, Messrs. Kerkam, Moore, Clarke, McNally, and Ball considered Tuesday decidedly the best day of the week for that character of reports, and Mr Ball considered Monday an admirable day for grangers' bulletins.

The following resolution by Mr Sage was adopted:

Resolved, That it is the sense of this convention that authority should be given to directors of State services to issue and mail weekly crop bulletins on Monday evenings, where in their judgment a wider dissemination could thereby be secured.

Messrs. McNally and Jennings were strongly in favor of having a printer and press at each station, in order that the reports might be issued in good shape. Mr. Sage thought each State should provide the necessary funds for such work.

Mr. Ryker offered the following resolution, which was adopted:

Resolved, That the National Weather Bureau should provide for the printing of the weekly weather-crop bulletins in those States and Territories that do not provide for such printing.

The third subject for discussion, "Uniformity in method and class of data published weekly and monthly," next occupied the attention of the assemblage.

The fourth subject, "Importance of directors and assistants in charge making a special study of the crops grown in the State. Since the majority of States have experimental stations, and that these stations are also voluntary stations, should not the time devoted to inspection of such stations cover several days so as to give the student opportunity to learn the important details connected with the growth of the several crops, etc.," was discussed at length by Messrs. Evans, Ball, Clarke, and others, leading to the following resolution (by Mr. Moore), which was adopted:

Resolved, That the State director should, by visiting the experimental stations, thoroughly familiarize himself with the cultivation of crops which are especial features of his State.

The fifth subject, "Value of an annual convention of the voluntary observers, displaymen, and weather-crop correspondents in each State, some State Fair day or at such time when the people of the State are drawn together," was admitted to be an excellent thing in those States were such fairs are held.

Mr. Moore of Wisconsin here moved that Mr. C. E. Linney, of Milwaukee, be elected to membership in the association, which motion was carried.

The sixth subject, "Is the work of the director or assistant in charge of a State service of such magnitude as to make his duties as local forecast official or observer in charge of station too onerous to give him the time to do as well for his service as he could do if he had only the duties of director," was next taken under discussion. Mr. Jennings was of opinion that the director should be relieved from station work so as to enable him to visit extensively throughout the State. Mr. Salisbury expressed himself as favoring a release from the duties of observer when the responsibility of director rested on him. Mr. Moore held an opposite opinion, believing the best results were obtainable where the two positions were combined. Mr. Ryker concurred. Messrs. Kerkam and Clarke preferred combining the two positions, but Mr. Evans said he thought the two would conflict, and that one man could not acceptably fill both.

Mr. Moore of Wisconsin offered the following resolution, which was adopted:

Resolved, That State weather services are so differently constituted that it would be impracticable to apply the same rules to all; and that the local exigencies of each case should determine whether the local forecast official and director should be one and the same person.

The seventh subject, "Relation of State weather services to experimental stations, and what will improve them," was next brought up and fully discussed by Messrs. Clarke, Pague, and others. Mr. Sage stated that the work had been proposed in Iowa, and some co-operation secured, and he approved the united action. Mr. Turner stated that the New York State weather service had furnished samples of diseased vegetation to agricultural experimental stations. In Kansas and Kentucky there has been some co-operation, and Mr. Burke of the latter State said that it had proved very advantageous. Mr. Conger, however, was not in favor of the detail of an observer at experimental stations, and said that the observations had not been properly taken when the instruments only had been furnished. The policy of the Government was opposed to extending aid to the co-operation of the services, a sentiment readily indorsed by Mr. Moore. Mr. Craig remarked that he was opposed to furnishing instruments, believing that they did not receive proper care. Mr. Ryker stated that in Virginia the experimental station furnished the poorest and most unreliable reports. Mr. Conger said that the records of the State central office could be used at the experimental stations for the purpose of determining the climatic conditions favorable for vegetation. Mr. McNally stated that his observers at experimental stations were very good, with the exception of a few months, when they were absent from station, and Mr. Pague said that in Oregon the reports were good from experimental stations.

Motion was here made by Mr. Craig that the meeting adjourn, seconded by Mr. Ryker, which, when put to a vote, was lost.

The eighth subject, "The necessity for more accurate measurement of snowfall," occupied considerable attention, Mr. Turner, of New York, discussing the subject very fully. Mr. Craig stated that the best method of measuring was to invert the funnel and collect the amount underneath, but Mr. Jennings was of the opinion that there was no accurate means of measuring snow.

The ninth subject, "The value of frost predictions and the best method of making them locally," was next presented to the convention, and Mr. Burke explained and discussed the methods used in Kentucky. Mr. Moore inquired what means of protection had been made, to which Mr. Burke replied that as yet no means had been tried. Mr. Moore stated that no protection, except for cranberries, had been made in Wisconsin; that water will protect cranberries from even a freezing temperature—local forecast officials should consider the condition of soil in making frost predictions.

The tenth subject, "Methods of protecting tender crops from frost," served as a topic for lengthy debate. Mr. Moore again advocated the means of flooding the cranberries for protection. Mr. Conger stated that in Alabama he had noted that the use of lumber was successful. Mr. Pague said that in Oregon mountain fires were a means of protection during the early autumn.

The following paper on "Frost predictions," by Mr. C. E. Linney, Milwaukee, Wis., was presented and read by Mr. Moore:

THE VALUE OF FROST PREDICTIONS AND THE BEST METHOD OF MAKING THEM LOCALLY.

Throughout all the States of the Union, the danger of late frosts in the spring and early frosts in the autumn has materially interfered with agriculture, and especially with horticulture. A series of frost charts which have been prepared from the data of the Bureau show, approximately, the dates of the first and last killing frost, from which it would appear that even the extreme Southern States are subject to severe frosts in the spring until March 1st; the Middle States from that date until May 1st, and the northern border line may catch a frost from that date until June 1st of sufficient severity to blast a crop just starting. While in the autumn the Northern States are subject to killing frosts by September 1st, the Middle States from that date to October 15th, and southward, leading out to the extreme southern border, frosts are liable to occur by December 1st. Even the central portion of Florida is not secure after December 15th.

The damage resulting from a severe and general frost, even over but a couple of the States of the Union, is best shown in the marked hesitation of growers to attempt early and tender crops, although always the most profitable, through fear of repeated losses in the same line and through the same cause. The loss in money value is difficult to ascertain, but it is without doubt represented by hundreds of thousands of dollars every growing season. And the danger is not over after the seeding and cultivating season is passed, for even then an early frost in the autumn will quite surely lay waste a summer's work, as would that of the spring a spring's work. In the case also of many plants, especially fruits, the damage is not restricted to one season or to the season at hand, but blasts the crop of the coming year and lends discouragement to the future.

In an agricultural country, such as the United States must largely be, and located as we are with a vast cold-wave producing region to the north of us,

from which flow most of the prevailing winds of late winter, early spring, and fall, the need of more careful and accurate investigation of frosts is at once apparent. A comprehensive and thorough investigation of their occurrence, the damage done, and the discovery of some means of mitigating their severity, together with an accurate and timely forecast, is imperative.

Frost in a general sense means a lowering of the temperature to 32°, but as applied to agriculture, especially as to temperature which will injure tender vegetation, a temperature much above freezing will too often, under favorable circumstances, cause material damage or wholly ruin the crop. A frost is largely the result of radiation, and the moisture which is deposited is a solid, supposed to be formed at the moment of deposition, and hence is not dew, although the two are closely allied, and a night favorable to dew, with slightly lower temperature, would also be favorable to frost. If, however, the temperature fall slightly lower and a frost occur without the white deposit, then the frost is a black one, and much greater damage will result. White frost will probably be deposited under favorable circumstances (clear sky, quiet air, a sandy soil, and the barometer above the normal or rising after the passage of a low) with the temperature as high as 45°.—Lieut. Allen says 47°. And frost is to be expected if the temperature fall to or below 40°, with heavy frost at 36°. Hence it is a common occurrence for a light frost to be reported in Wisconsin when the Weather Bureau stations surrounding do not report a temperature below 45° to 50°, and often when the reported temperatures are above 50°; a fact which indicates most clearly the necessity of country air readings as a guide to an accurate knowledge of the temperature to which crops are exposed. This same fact is also, in a way, proof of the radiation theory of frost, since the murky, smoky, heated air of the towns and cities will often resist the approach of frost while the country around is subjected to severe frost.

As radiation is the cause of frost and the rapid cooling of the plant results in its own death, it follows that anything which will retard this radiation will in many cases entirely overcome the frost deposit. Clouds accordingly prove good protection; thick banks of smoke answer the same purpose; and light frames with canvas drawn over the plants save them night after night. In Wisconsin the plan of smudging in those parts of the State largely devoted to tobacco raising has been little practiced, but with cranberry growers the well known flooding process affords ample protection as long as the reservoirs have water.

A suggestion might not be out of place: An interesting and valuable series of observations could be instituted if temperature readings were taken at hourly intervals at various elevations from the surface of the ground upward to a height of 8 to 10 feet—the elevation at present recommended for the Weather Bureau instrument shelters. I am informed by reliable men who have carried on a limited series of observations that a difference of 10° to 15° is frequently found to exist over the cranberry bogs and on sandy soil between the surface and above the elevations. It will, therefore, be readily seen that the present system of city and elevated readings is very faulty in frost predictions. Until a complete and correct system of deductions has been made showing the occurrence of frosts with the temperatures reported by the Weather Bureau station, the present system of forecasts must be largely or entirely a matter of individual estimation and guessing.

The hygrometer system of frost predictions is undoubtedly the one to be most generally recommended to the individual observer, and, once he is familiar with the ordinary clearing weather and wind signs of his section, he can, by the aid of the wet and dry bulb, form a fairly accurate idea of what minimum temperature to expect during the night.

The remarkable rapidity with which cold-air currents will seek the lower levels and fill the valleys as the frost season approaches is a matter of no little moment, and could some system be devised to secure the intermingling of the warmer upper strata and hill temperatures with those which have poured into the valleys through air drainage, and which too often carry with them frosts which the uplands escape, the result would no doubt prove to be beneficial, and a frost would frequently be diverted which would otherwise prove destructive to vegetation.

The charted conditions which give frosts to the country are similar in many respects to the more severe frost periods which the cold waves of winter bring. The dry, calm, clearing air of the high pressure area or the rising barometer after the passage of a low, the down flow of upper currents, the drawing in of the lower temperatures of the north and northwest, and the corresponding rapid and regular approach of the frost line from the northwest to the south, southeast, and east are but a reproduction on a milder plan of the cold wave of the winter. Lieut. Woodruff, in a series of interesting tables on the progress of cold waves, has shown that of all cold waves that reach central North Dakota from Montana 71 per cent of them arrive in eight hours and 93 per cent in twenty-four hours; 73 per cent reach Saint Paul inside of twenty-four hours and 91 per cent inside of thirty-two hours; 88 per cent reach Omaha inside of twenty-four hours and 96 per cent inside of thirty-two hours; 56 per cent reach Chicago inside of twenty-four hours, 72 per cent inside of thirty-two hours, and 93 per cent inside of forty-eight hours; 53 per cent reach Saint Louis inside of twenty-four hours, 77 per cent inside of thirty-two hours, and 95 per cent inside of forty-eight hours; 53 per cent reach Buffalo inside of thirty-two hours, 80 per cent inside of forty-eight hours, and 96 per cent inside of sixty-four hours; and, finally, that 46 per cent reach Washington inside of forty hours, 58 per cent inside of forty-eight hours, 71 per cent inside of fifty-six hours, and 88 per cent inside of seventy-two hours, from which it would appear, allowing a reasonable difference for the slow progress of frost-bearing winds, that twenty-four to thirty-six hours would include much of the north, west, and central portions of the country in an advancing frost wave, and that that portion remaining untouched at the end of thirty-six hours, except the season be well advanced and freezing temperatures general, would not be touched by the frost wave, other weather conditions having overcome the cold.

The following examples of successful frost predictions by Mr. Moore may be of interest: the frost of August 22–23, 1891. On the morning of August 21st a low area was central in the upper Saint Lawrence Valley, a high area of 30.4 inches was central in the Northwest Territory and Montana. Fresh westerly winds were flowing out over all of the western country, and the following temperatures (minimums) were reported: Fort Buford, 42°; Bismarck, 50°; Moorhead, 52°; Milwaukee, 60°, and the other bordering stations, including Saint Paul, Duluth, Marquette, La Crosse, and Green Bay, 58°. On the morning of the 22d the high barometer covered the entire western country with two centers, one over Wyoming and Colorado and the other over northeast Montana. Fresh northwest winds and clear weather prevailed over Wisconsin, except at Saint Paul and La Crosse, where the weather was cloudy. The temperatures reported were: Bismarck, 44°; Huron, 40°; Moorhead, 38°; Saint Paul, 46°; Duluth; 46°; La Crosse, 48°; Marquette, 48°; Green Bay, 50°; and Milwaukee, 56°. Severe frosts were predicted to occur that night. On the morning of the 23d the center of the high barometer was over the Missouri Valley, and extended south from South Dakota and western Minnesota. The weather was cloudy along the east shore, otherwise clear; winds light to fresh from the north, with the following temperatures: Bismarck, 36°; Moorhead, 34°; Huron, 34°; Saint Paul, 42° Duluth, 44°; Marquette, 50°; La Crosse, 42°; Green Bay, 48°; and Milwaukee, 53°. Light showers had occurred over the entire State in the twenty-four hours previous. Nevertheless frosts were general over the State, and the Dakotas and Minnesota had very severe frosts. The synopsis on the morning map of the 24th says: "Great damage is reported to tobacco and cranberries by frosts in Wisconsin. These frosts were forecasted by the Milwaukee office on Friday morning and warnings were sent to fully one hundred points in the State, stating that light frosts would occur Saturday the 22d, and severe frosts Sunday (23d) morning."

The frosts of August 27–28, 1891: On the morning map of the 26th (Wednesday) a low area was central over the east point of Lake Superior, and cloudy weather and fresh westerly winds prevailed over Wisconsin. High barometer was developing over Montana. Temperatures reported by the stations were 44° at Bismarck, 42° at Moorhead, 42° at Huron, 38° at Fort Buford, 46° at Custer, 50° at Duluth, 52° at Saint Paul, 58° at La Crosse, 56° at Marquette, 60° at Green Bay and Milwaukee. The morning forecast read as follows: "For Wisconsin, fair this afternoon and Thursday. Light frosts are indicated to-night, particularly in north portion. Heavy frosts Thursday night. Northwest winds." On the morning of the 27th (Thursday) the high barometer covered the entire country to the west of the Mississippi, with center over Nebraska, 30.4. The weather was cloudy over the east and south portions of Wisconsin, balance clear, wind fresh northerly. Temperatures reported were: Bismarck, 36°, killing frost; Huron, 40°; Moorhead, 42°; Saint Paul, 46°; Duluth, 48°; La Crosse, 50°; Marquette, 50°; Green Bay, 56°; and Milwaukee, 58°.

Light frosts occurred in all north and northwest counties. The forecast for that day read: "For Wisconsin, fair and slightly cooler to-day and until Friday evening, with northwest winds; frosts to-night." On the morning of the 28th (Friday) the high barometer was central over the middle Mississippi valley and two low areas appeared, one in the Saint Lawrence Valley and the other over Manitoba. The weather over Wisconsin was partly cloudy, with the wind light and variable. Temperatures reported were: Moorhead, 44°; Duluth, Saint Paul, Marquette, and Green Bay, 40°; La Crosse, 38°; and Milwaukee, 48°. The following extract from the morning synopsis explains the situation: "The lowest temperatures anywhere this morning were in Wisconsin and over the Lake Superior country. Frosts occurred last night in the tobacco and cranberry regions of the State, and light frosts were even observed in the country about Milwaukee. Wednesday (the 26th) the Milwaukee office sent warnings throughout the State forecasting this frost. The lowest temperatures of the season in Wisconsin were recorded, as follows: La Crosse, 38°; Milwaukee, 47°; Green Bay, 44°; and Duluth, 24°." It must be remembered that these temperatures are recorded in cities, and that the minimum in the surrounding country was 10° to 15° lower.

Other examples are the frosts of August 19 and 20, 1892; those of August 29th and 30th; those of September 5th and 6th; those of September 15, 16, and 17, 1892; and many others.

In conclusion, it is well to impress upon those who would make a success of frost predictions the necessity of a careful study of the State's topography and soil formation. A mental map of its principal rivers, valleys, watersheds, and elevations, with an idea of its general contour, is of great assistance. An exact knowledge also should be acquired of the perishable crops grown, and the sections of the State in which warnings would be of most benefit in saving those crops, that he may at all times place a warning where it will do the most good, and he will be able to announce the advance of many frost waves without being compelled to acknowledge (publicly at least) their killing qualities.

The subject of telegraphing daily warnings was discussed very fully. Messrs. Moore and Strong were in favor of daily warnings, and Mr. Kerkam stated that he had found the plan of telegraphing forecasts only when marked changes

are expected preferable in Louisiana. Mr. Jennings thought the method of sending out forecasts from certain central stations by the Government was bad, inasmuch as certain points were not reached as speedily as they should be, Mr. Kerkam explaining why this was done—to save expense.

The convention then adopted the following resolution, offered by Mr. Burke of Kentucky:

Resolved, That the method of sending forecasts daily is the most satisfactory to the public, and that the present method of sending them only when marked changes are expected should be discontinued at the earliest practicable time.

The Treasurer's report was then read and approved, and the Committee on Resolutions being ready made their report, in accordance with resolutions already given in their proper places.

Upon motion of Mr. Conger the by-laws were amended to provide for an executive committee of three, with the president as an *ex officio* member, to which shall be referred all matters for the improvement of the service that may arise between meetings, the members of said committee to be elected by the members of the association annually.

Election of officers.

The election of officers for ensuing year was next in order of business. Mr. Jennings suggested the re-election of present officers, to which Mr. Kerkam objected as related to himself. The following gentlemen were then put in nomination:
For President, Messrs. Dunwoody, Burke, Pague, and Clarke;
For Vice President, Messrs. Clarke, Burke, Pague, Moore, and Salisbury;
For Secretary, Messrs. Berry and Evans;
For Treasurer, Messrs. Salisbury, Strong, and Evans;
Executive Committee, Messrs. Moore, Conger, Jennings, Ball, and Evans;
which resulted in Major Dunwoody being elected President, unanimously, by a rising vote; Messrs. Clarke and Burke First and Second Vice Presidents, respectively, by acclamation; Mr. Berry as Secretary, by acclamation; Mr. Salisbury as Treasurer, unanimously, and the Executive Committee, to be composed of Messrs. Ball, Conger, and Jennings, unanimously.

On motion, duly seconded, meeting was adjourned until next year.

METEOROLOGICAL TABLES.

Meteorological record of voluntary and other co-operating observers, August, 1893.

Stations.	Temperature. (Fahrenheit.) Max.	Min.	Mean	Precip'n.
Alabama.	°	°	°	*Ins.*
Alco	93	64	79.6	.....
Bermuda *†[5].	91	64	78.4	.....
Birmingham †	94[e]	68[e]	82.0[e]	4.61
Brewton †	100	60	79.8	6.45
Camden *[1]	94	67	80.6	2.51
Carrollton *†[1]	90	62	78.0	3.40
Citronelle †	91	69	80.4	3.90
Claiborne Landing †	.....	.....	.....	3.47
Clanton †	98	70	86.3	0.20
Cordova †	.....	.....	.....	1.40
Decatur *a* †	.....	.....	.....	1.84
Decatur *b* †	92	52	75.8	1.82
Demopolis †	.....	.....	.....	4.46
Elba *†[1]	88	69	77.0	7.66
Eufaula *a* †	100	68	80.8	8.85
Eufaula *c* †	.....	.....	.....	6.80
Evergreen †	94	62	78.5	7.05
Florence *a* †	.....	.....	.....	1.72
Florence *b* †[1]	93	55	77.6	1.21
Fort Deposit †	93	64	79.8	4.68
Gadsden †	.....	.....	.....	3.07
Geneva †	98	68	82.0	0.95
Greensboro †[1]	92	62	77.8	7.72
Healing Springs †	95	65	81.2	6.82
Highland Home †	92	68	79.0	9.12
Livingston *b* †	94	59	79.7	8.51
Lynn *a* †	.....	.....	.....	2.45
Maple Grove[1]	99[e]	55	79.8	3.83
Marion †	94	62	80.8	2.71
Maysville †	94	60	79.0	4.74
Mount Willing †	94	63	79.8	3.23
Newbern †	91	65	79.6	5.21
Newburg †	98	50	77.4	3.01
Newton †[1]	95	66	77.8	8.74
Opelika †	94	66	79.6	5.69
Pine Apple †	95	60	79.2	4.23
Pushmataha †[1]	91	65	79.4	1.82
Rock Mills	91	62	77.5	8.19
Selma *a* †	.....	.....	.....	4.21
Starlington	.....	.....	.....	6.90
Sturdevant †	.....	.....	.....	7.33
Talladega †	.....	.....	.....	6.08
Tallassee Falls †	.....	.....	.....	7.26[d]
Thomasville †	94	62	79.6	2.51
Tuscaloosa †	.....	.....	.....	4.75
Tuscumbia *a* *[1]	95	65	77.9	1.72
Tuscumbia *b* †	94	59	79.5	1.60
Union Springs *a* †[1]	94	64	79.4	10.51
Union Springs *b* †	94	66	78.9	11.24
Uniontown †	94	61	80.6	4.07
Valley Head †[1]	91	56	74.7	1.78
Warrior †	.....	.....	.....	2.07
Wilsonville †	.....	.....	.....	6.08
Alaska.				
Killisnoo †[1]	65	45	54.6	9.90
Metlakahtla †	74	36	54.4	6.87
Arizona.				
Antelope Valley †	.....	.....	.....	4.28
Ariz. Canal Co. Dam	109	72	90.9	1.45
Arizona—Cont'd.				
Benson *[8]	101	61	79.0	3.03
Bisbee †[1]	92[b]	60	71.8	4.15
Buckeye †	108	65	88.2	1.50
Calabasas †	93	58	76.0	2.73
Casa Grande *[8]	106	80	89.3	0.95
Crittenden *†[5]	96	58	73.8	5.68
Dragoon †	.....	.....	.....	4.49
Dragoon Summit *[5]	100	60	82.0	3.19
Dudleyville †	103	68	85.2	1.38
Farleys Camp	96	66	80.0	4.27
Flagstaff *†[1]	84	40	64.8	0.66
Florence †	106	70	87.8	1.34
Fort Apache	93	50	71.0	3.43
Fort Bowie †	93	61	75.5	3.41
Fort Grant	100	58	75.6	2.00
Fort Huachuca	92	57	72.4	8.99
Fort Mohave	116	72	93.8	T.
Gila Bend *b* *[8]	106	65	85.5	1.79
Holbrook †	94	51	73.4	2.76
Maricopa *[8]	114	75	92.6	0.50
Mount Huachuca †	90	60	73.0	4.84
Natural Bridge †	.....	.....	.....	4.99
Oracle †[1]	94	55	75.2	.....
Oro	.....	.....	.....	2.47
Pantano *[8]	101	75	85.2	0.15
Payson *[1]	91	56	72.0	2.75
Peoria †	106	72	88.8	1.42
Red Rock *†[5]	105	79	90.1	2.95
Reymert †	100	64	81.6	3.34
Rye †	.....	.....	.....	2.42
St. Helena R'h *†	92	63	73.5	5.82
San Carlos	110	59	83.2	3.78
San Simon *[8]	102	72	82.1	2.22
Show Low	.....	.....	.....	2.13
Signal †	109	69	89.2	1.88
Teviston	.....	.....	.....	1.01
Texas Hill *[8]	113	80	94.7	0.00
Tombstone †	98	58	76.4	3.75
Tucson *a* †	106	67	84.4	5.65
Tucson *b* *[8]	101	78	87.7	2.74
Walnut Ranch *†[1]	92	64	72.4	5.25
Whipple Barracks	91	46	69.0	4.30
Wilgus †	.....	.....	.....	4.29
Willcox *[8]	99	76	87.4	1.03
Wood Canyon	.....	.....	.....	7.00
Yuma *[8]	108	84	92.8	0.42
Arkansas.				
Arkadelphia †	.....	.....	.....	5.68
Arkansas City †	.....	.....	.....	5.75
Ashdown †[1]	99	54	78.6	2.24
Bee Branch †	98	55	77.8	2.45
Brinkley †	97	56	76.3	2.84
Camden *a* †	.....	.....	.....	2.77
Camden *b* †[1]	94	56	75.4	1.28
Conway *[1]	93	61	75.6	1.27
Corning †	96	49	74.9	0.95
Dallas †[1]	95	60[e]	74.8	4.62
Dardanelle †	.....	.....	.....	2.15
Fayetteville †	93	48	73.1	5.80

Meteorological record of voluntary observers, &c.—Continued.

Stations.	Temperature. (Fahrenheit.) Max.	Min.	Mean	Precip'n.
Arkansas—Cont'd.	°	°	°	*Ins.*
Forrest †	96	57	79.4	2.20
Fulton †	.....	.....	.....	2.22
Gaines Landing †	.....	.....	.....	4.47
Hamburg	95	56	77.0	9.40
Helena *a* †	.....	.....	.....	2.14
Hot Springs	99	52	77.6	3.26
Keesees Ferry †	96	48	74.4	3.02
Kirby †	95	51	76.0	3.05
Lonoke *[1]	97	58	80.0	2.81
Madding [2]	.....	.....	78.9	4.62
Malvern †	93	54	75.1	3.43
Marcella †	97	65	81.2	0.95
Marshall †	.....	.....	.....	5.70
Melbourne †	97	50	76.0	0.70
Mount Nebo †	97	51	73.0	1.88
New Gascony *[1]	96[d]	62[e]	78.9[f]	3.37
Newport *a* †	.....	.....	.....	2.44
Newport *b* †	97	58	78.4	2.56
Newport *c* †	95	54	76.0	1.80
Osceola †[1]	93	57	77.1	0.65
Ozark †	99	56	79.0	3.85
Pine Bluff †	100	60	80.4	3.26
Prescott †	93	60	78.4	1.79
Rison †	99	56	79.8	3.09
Rogers †	.....	.....	.....	4.33
Russellville †	97	51	77.7	2.02
Stuttgart †	95	55	77.5	2.97
Texarkana †	98	58	80.6	1.88
Warm Springs *[1]	102	60	76.4	0.67
Washington *b* †[1]	97	56	79.0	1.17
Wiggs	.....	.....	.....	5.50
Winslow *†[1]	83	58	73.2	7.19
California.				
Anaheim *[8]	94	58	74.5	0.00
Anderson *[1]	106	56	75.8	0.00
Antioch *[8]	104	58	73.9	0.00
Aptos *[8]	80	49	60.7	0.00
Arcata †	70	45	56.6	0.00
Arlington Heights	100	53	76.0	0.00
Athlone *[8]	106	64	83.6	0.00
Auburn *[8]	102	48	76.6	0.00
Bakersfield *a* *[8]	108	72	85.1	0.00
Ballast Point L. H.	.....	.....	.....	0.00
Barstow †	106	54	82.0	0.00
Beaumont *[8]	102	67	80.8	0.18
Belmont *[8]	88	56	68.4	.....
Berendo *[8]	112	70	88.7	0.00
Berkeley	76	50	60.6	0.00
Bishop Creek *[8]	102	70	83.9	T.
Boca *[8]	92	35	61.5	0.05
Borden *[8]	109	63	83.6	0.00
Boulder Creek *[8]	99	45	59.7	0.00
Brentwood *[8]	106	60	73.7	0.00
Brighton *[5]	112	58	81.2	0.00
Byron *[8]	103	50	74.4	0.00
Caliente *[8]	105	60	83.2	0.00
Calistoga *[8]	100	54	72.6	0.00
Campo Seco	.....	.....	.....	0.00
C. Mendocino L. H.	.....	.....	.....	0.00
Capitola *[8]	76	52	63.1	0.00
California—Cont'd.				
Castroville *[8]	72	52	61.1	0.00
Centerville *[1]	96	.....	66.4	0.00
Chico *[8]	108	58	78.5	0.00
Chino *[6]	98	59	75.2	0.00
Cisco *[8]	82	42	62.1	0.00
Citrus *[2]	108	.....	78.5	0.00
Claremont †	96[d]	50[d]	72.0[d]	0.00
Cloverdale *[1]	106	52	77.0	0.00
Colfax *[8]	99	58	81.6	0.00
Colton *[8]	105	58	78.8	0.00
Colusa †	102	53	75.6	0.00
Corning *[8]	112	62	80.0	0.00
Crescent City	.....	.....	.....	0.00
Crescent City L. H.	.....	.....	.....	0.00
Crofton *[8]	100	60	81.0	0.00
Davisville *a* *[8]	106	60	77.3	0.00
Davisville *b*	102	53	75.1	0.00
Delano *[8]	104	70	86.0	0.00
Delta *[8]	108	60	79.4	0.00
Dinuba *[8]	102	70	85.1	T.
Downey *[8]	94	62	74.6	0.00
Dry Creek *†[3]	.....	59	73.3	.....
Duarte	100	52	75.0	0.00
Dunnigan *[8]	104	64	80.0	0.00
Dunsmuir *[8]	98	50	68.5	0.00
East Brother L. H.	.....	.....	.....	0.00
Edgwood *[8]	93	51	67.7	0.00
Edmanton *[1]	93	45	64.4	0.00
El Casco *[8]	108	60	79.9	0.00
Eldorado *[8]	105	63	80.0	0.00
Elmira *[8]	107	57	79.4	0.00
El Verano *[8]	97	55	69.2	0.00
Emigrant Gap *[8]	85	53	68.0	0.00
Esparto *[8]	111	58	80.0	0.00
Evergreen	.....	.....	.....	0.00
Exeter *[8]	102	73	83.9	0.00
Fall Brook *[1]	98	55	70.6	0.00
Farmington *[8]	106	60	79.0	0.00
Felton *[8]	102	44	69.6	0.00
Fernando *[8]	100	50	73.0	0.00
Florence *[8]	89	62	73.6	0.00
Florin *[8]	104	55	72.5	0.00
Folsom City *a* *[8]	108	65	81.2	0.00
Folsom City *b* *[1]	107	66	78.8	0.00
Fort Bidwell	97	39	69.4	0.05
French Corral	100	59	77.7	0.00
Fresno *[8]	107	65	83.9	0.00
Fruto *[8]	106	62	81.6	0.00
Galt *[8]	106	63	79.1	0.00
Georgetown †	97	56	76.0	T.
Gilroy *[8]	106	57	67.6	0.00
Girard *[8]	95	65	76.4	0.00
Glen Ellen *[8]	99	52	67.6	0.00
Goshen *[8]	110	57	80.3	0.00
Grass Valley *a*	.....	.....	.....	0.00
Haywards *[8]	85	55	63.8	0.00
Healdsburg *[1]	96	46	63.3	0.00
Hollister *[8]	101	47	61.7	0.00
Hornbrook *[8]	102	56	76.1	0.00
Humboldt, L. H.	.....	.....	.....	0.00